NWS Supporting Decision Making in the Arctic

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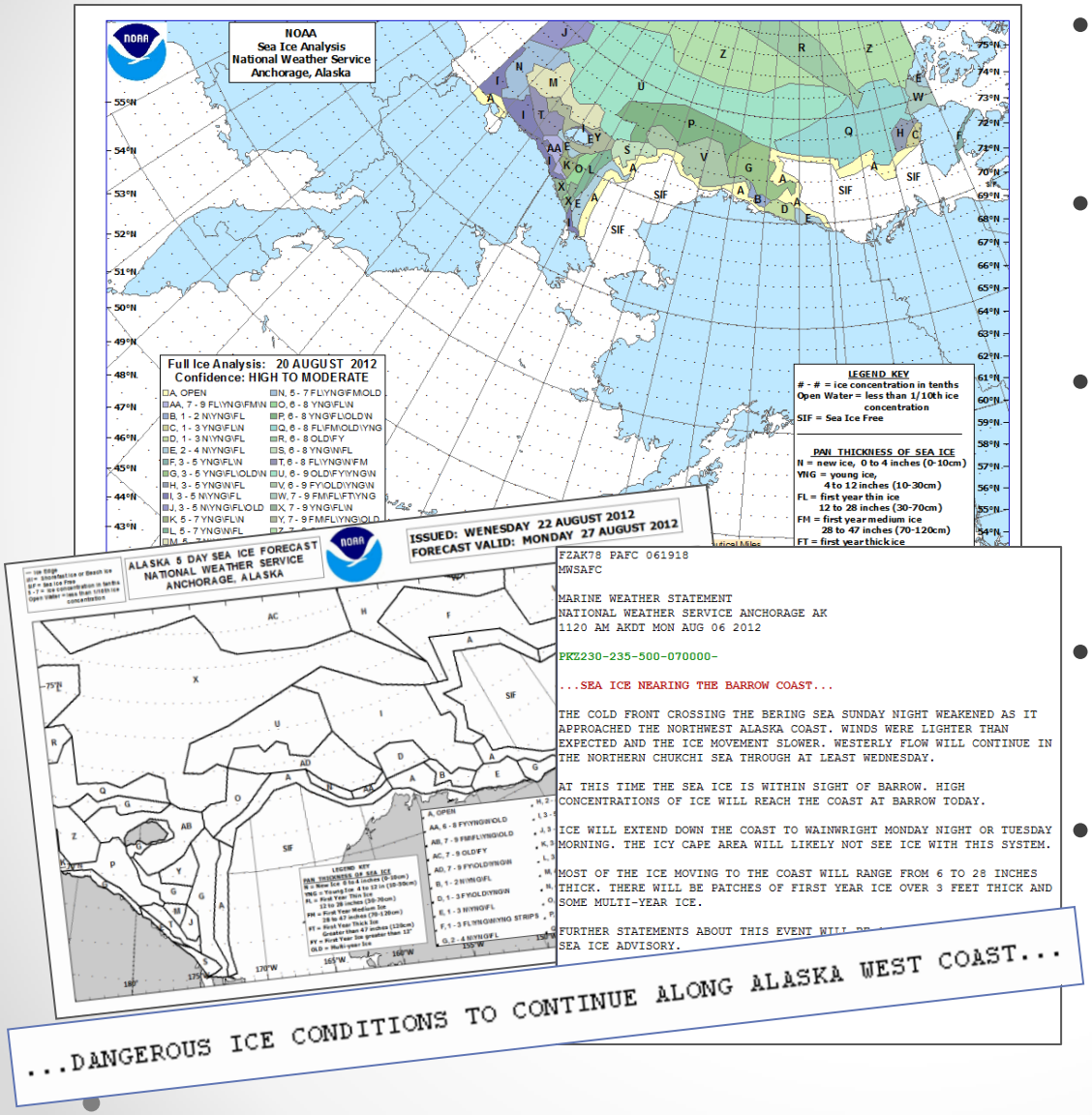
38th Climate Diagnostics and Prediction Workshop
October 24, 2013

Outline

- NWS Alaska Sea Ice / Weather Services Overview
- Arctic Decision Support Activities
- 2012 Decision Support Activities with BOEM
- Lessons Learned and Challenges

NWS Alaska Sea Ice Services Overview



- Sea ice analysis and forecasts ***focused*** on Alaska waters
- High resolution, local scale for tactical decisions
- Delivery meets user requirements
  - GIS enabled
  - Low-bandwidth for MarineFax
- Fully integrate ***sea ice*** and ***weather*** into coastal and marine services
- Stakeholders: subsistence hunters to ice breakers

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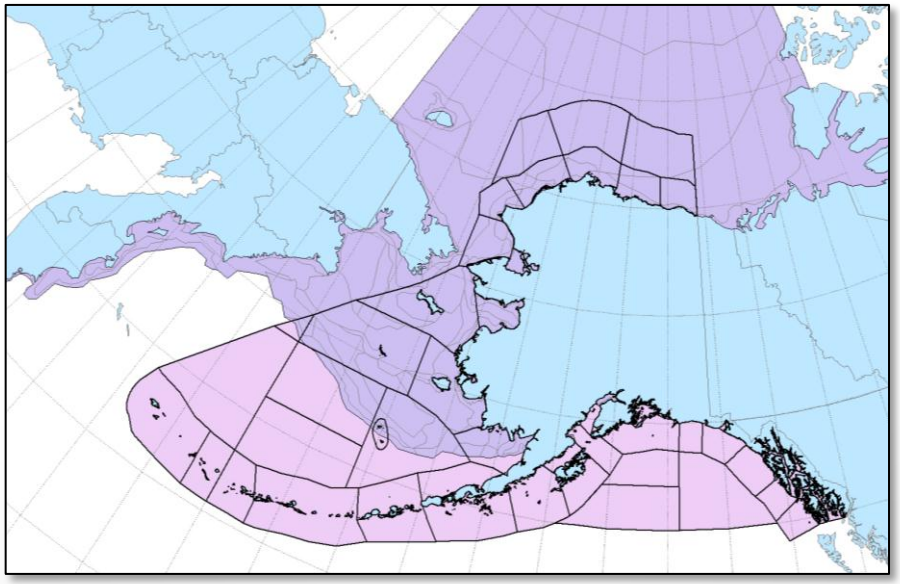
Routine NWS Sea Ice Services

- 3x Weekly Detailed Ice Analysis – Coordinated with the NIC
- 3x weekly 5-day ice forecasts for Alaska Waters
- 2x weekly sea surface temperature analysis
- Monthly ice melt-out/freeze-up outlooks for points along Alaska coastline
- ***Detailed tactical support services as requested***



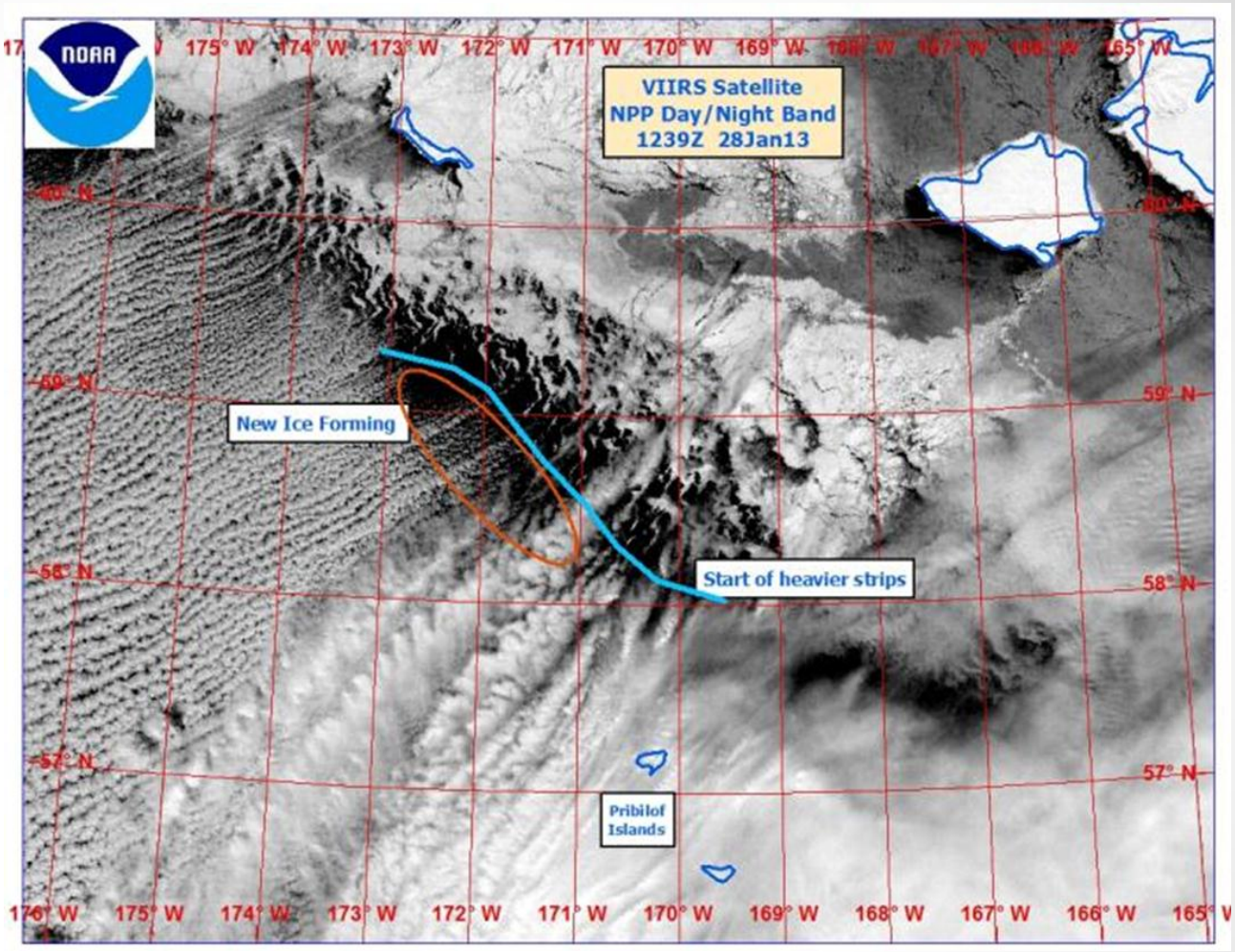
Marine Weather and Sea Ice Forecast Area of responsibility outlined in black

Decision Support for Alaska Fishing Fleets

- Bering Sea Fishery ($4 Billion per year)
- Ship Captains often consult the ice forecaster for immediate data on ice position and movement
- Ice isn't necessarily bad – With the proper information available to ship captains it can provide a safe haven.

F/V Bering Star
March 2008

SNPP VIIRS
Day/Night Band



Sea Ice offers Protection from highs seas and
Freezing Spray - The #1 threat to Alaska Mariners

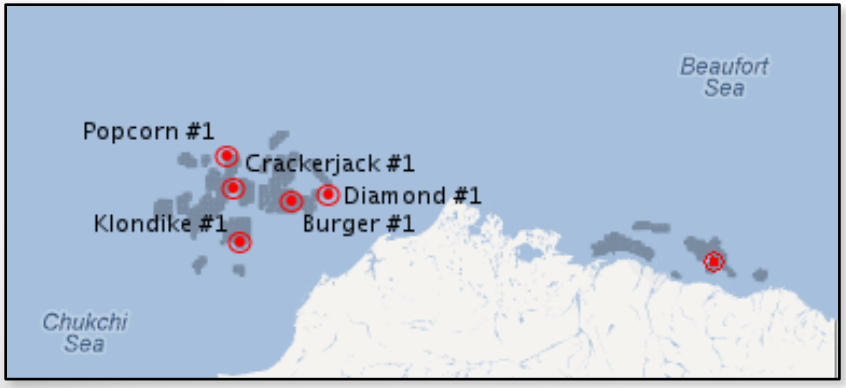
The Alaska Ice Desk in coordination with the NIC provided 24 hour support to the USCG Ice Breaker Healy during its escort of the tanker Renda for an emergency fuel delivery to Nome

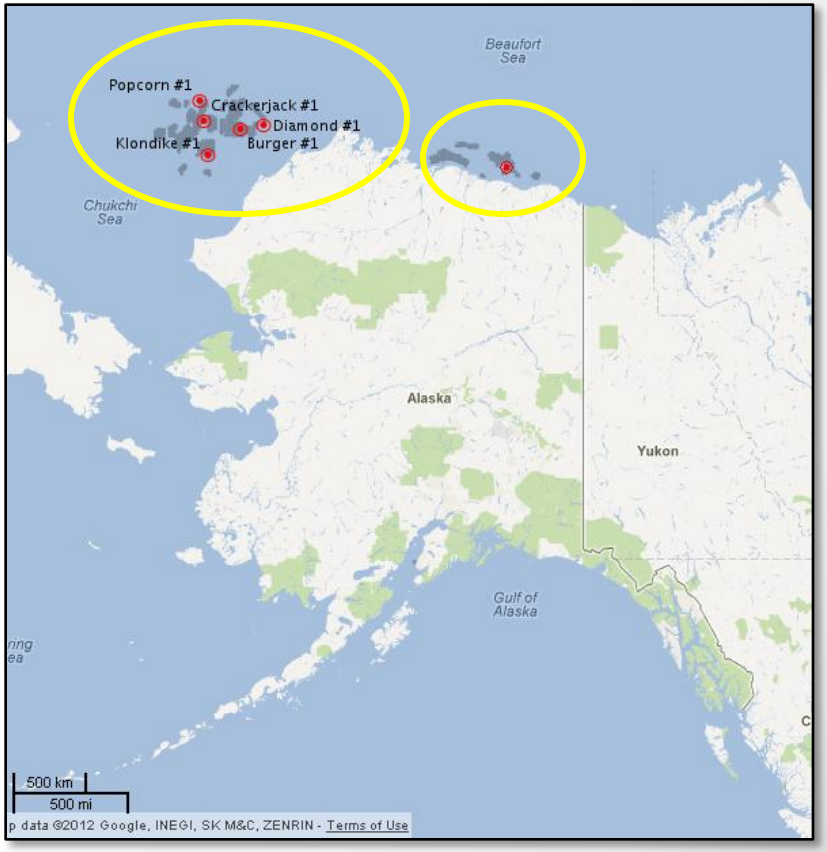
Nome Fuel Resupply
Dec 2011 - Jan 2012

Decision Support for the Department of Interior

In Early September 2012, Bureau of Energy Management (BOEM) requested NOAA support to:

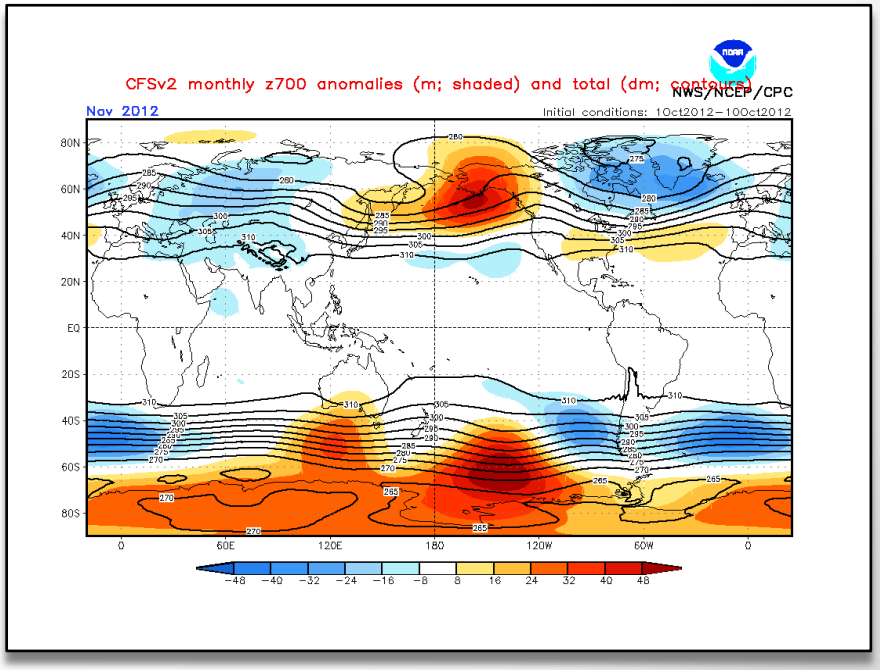
- Provide our best forecast for freeze-up at the Burger drill site
- Provide weekly updates to the initial ice forecast and weather conditions of significance to operations





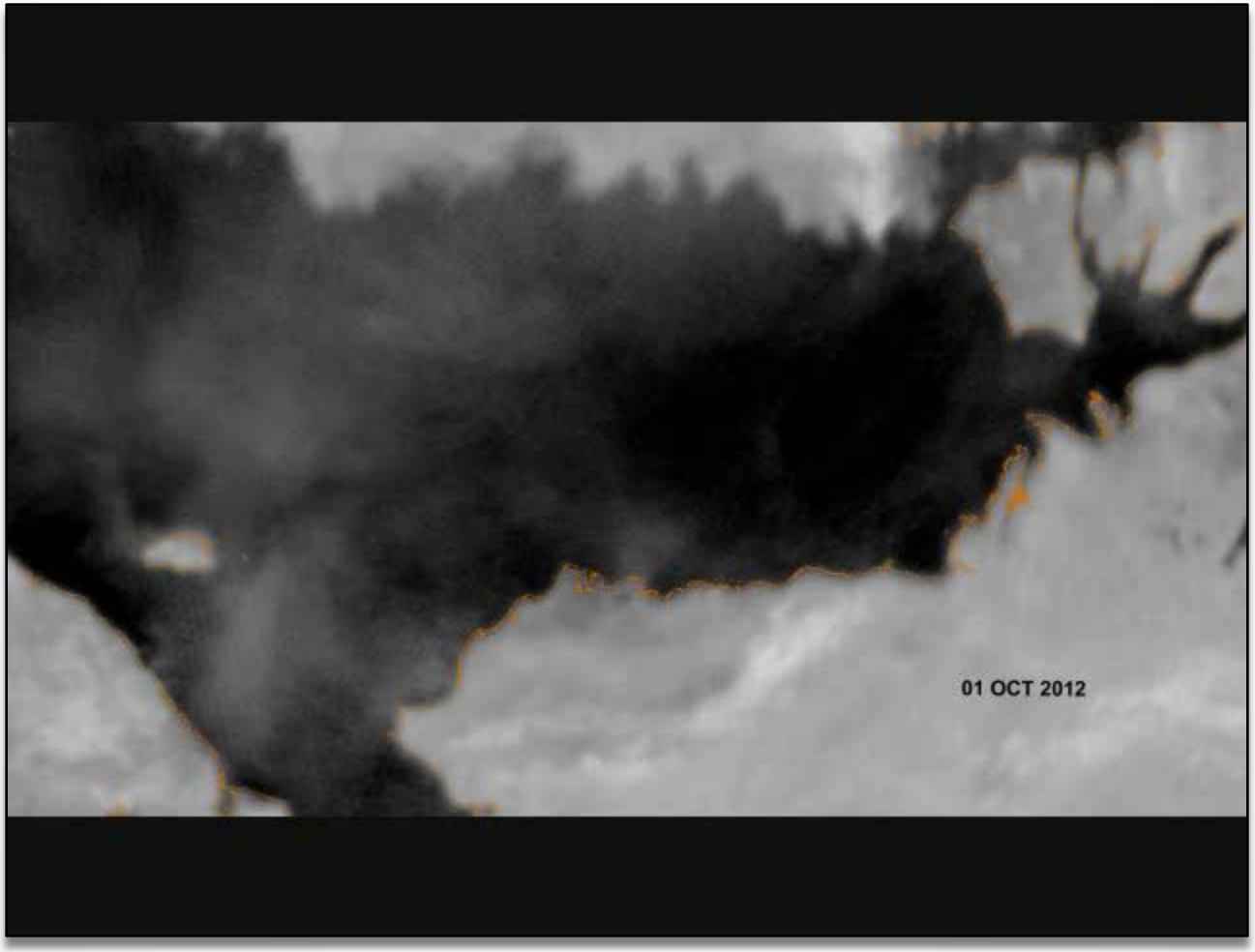
Initial Forecast and Weekly Updates Provided to BOEM

- Coordinated NOAA Sea Ice Outlook provided in early September:
  - Most probable date of freeze-up to occur at Burger between Nov 8 to Nov 12
  - 30% chance that freeze up would occur by October 28th
  - 70% chance freeze-up would occur by November 22nd
  - Large uncertainties in sea ice forecasting for that area.
- Weekly Briefings Provided:
  - Analysis of current sea ice and sea surface temperature conditions and weekly trends in the Arctic and vicinity of the Burger Site
  - Description of how the weather patterns influenced the weekly trends
  - Discussion of weather /climate model guidance and ice formation potential
  - How these factors impact the initial September forecast



Example NCEP's CFS Forecast November Mean Circulation And Anomalies

Ice Development – October



Scatterometer data (Video courtesy of Shell)

Freeze-up at Burger Site

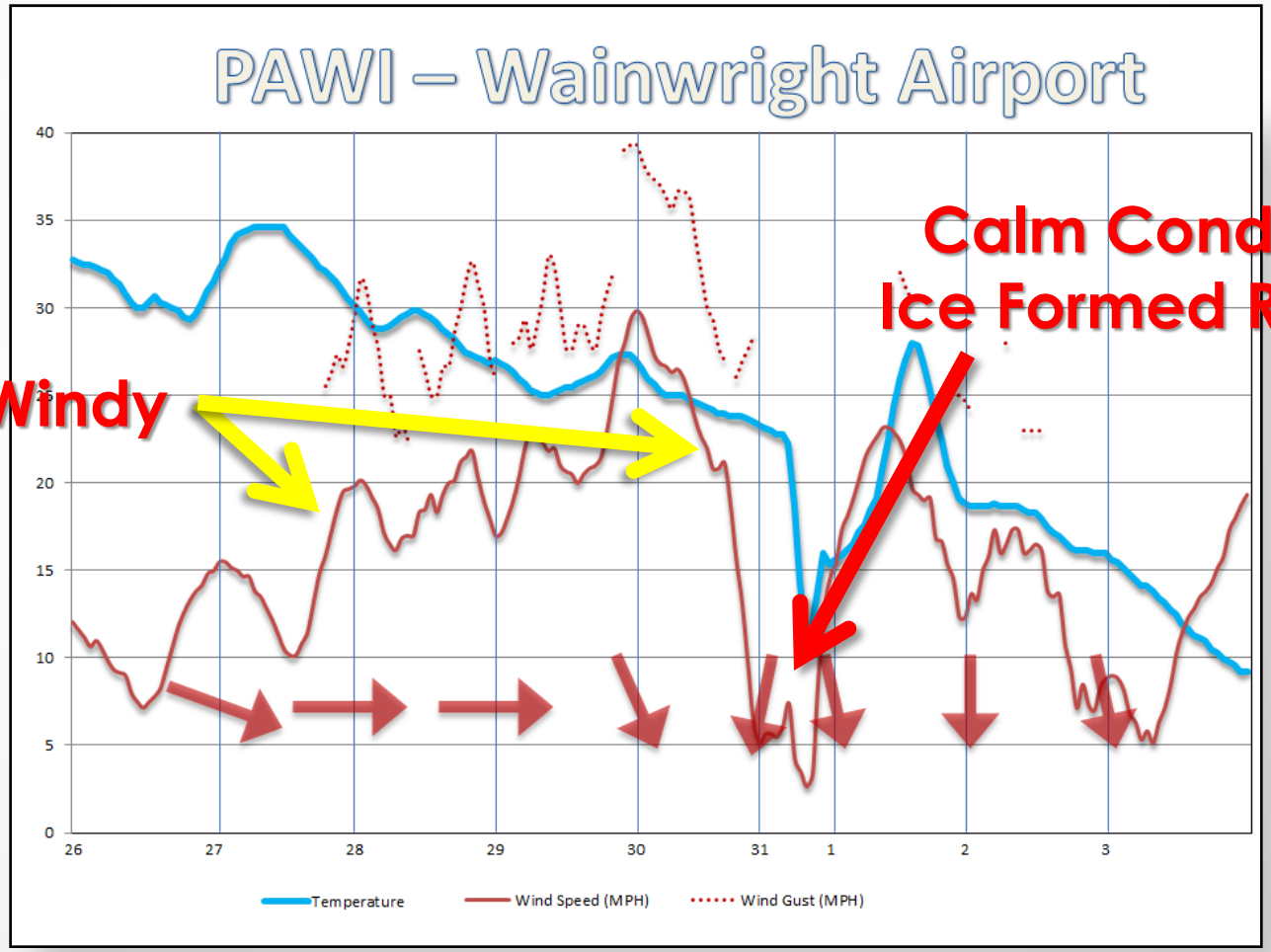
- Freeze-up occurred rapidly on October 31st and November 1st
- Was this a "Flash Freeze" event?
  - Cold windy conditions very efficiently removed heat from the ocean
  - A period of calmer weather followed leading to the extremely rapid freeze-up
- Such an event had not been observed in this region so far south of the main ice edge during the last 20 years

NIC Sea Ice Analysis

Ice Extent October 30st

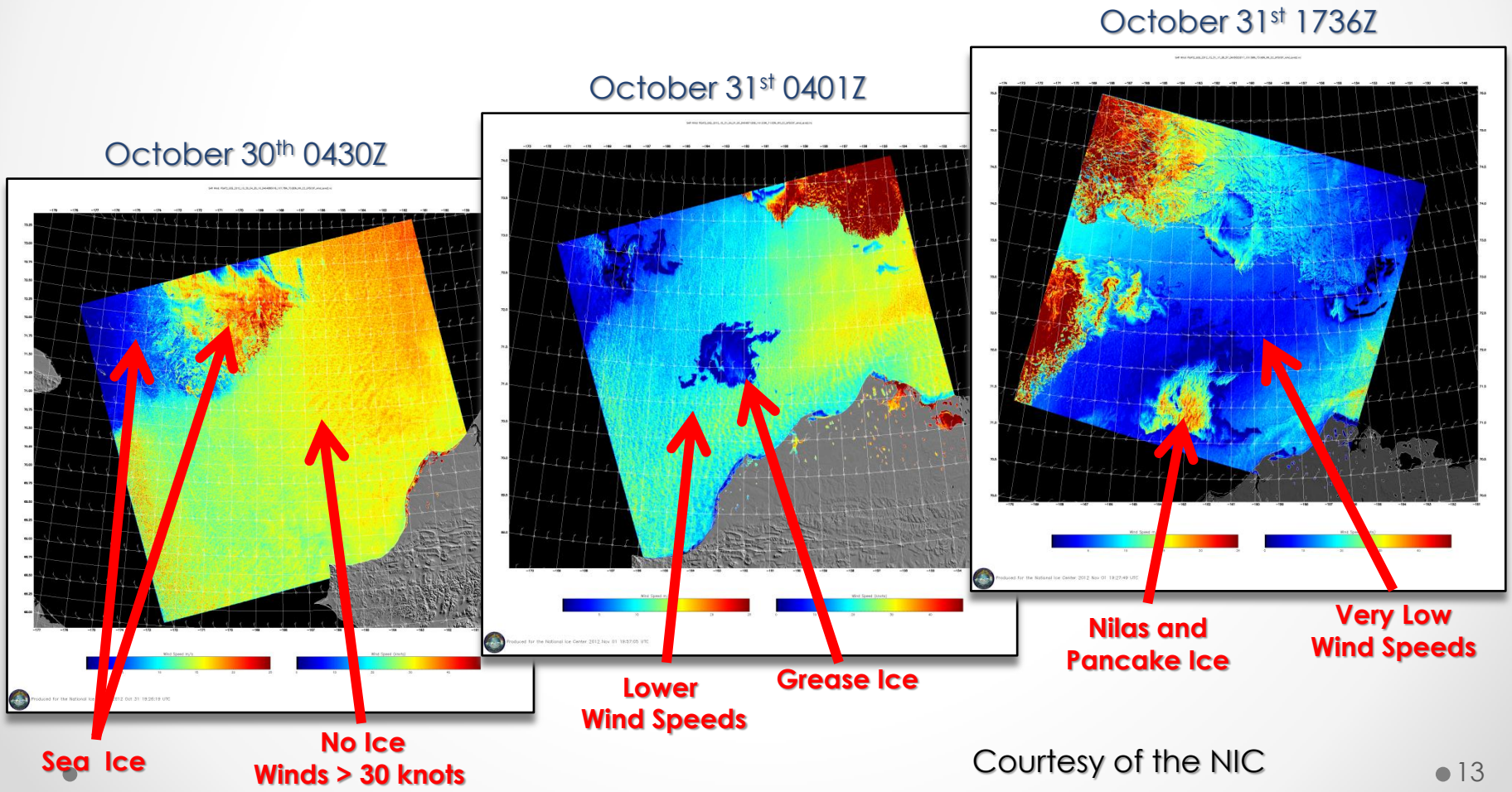
Ice Extent November 1st

Freeze-Up Conditions



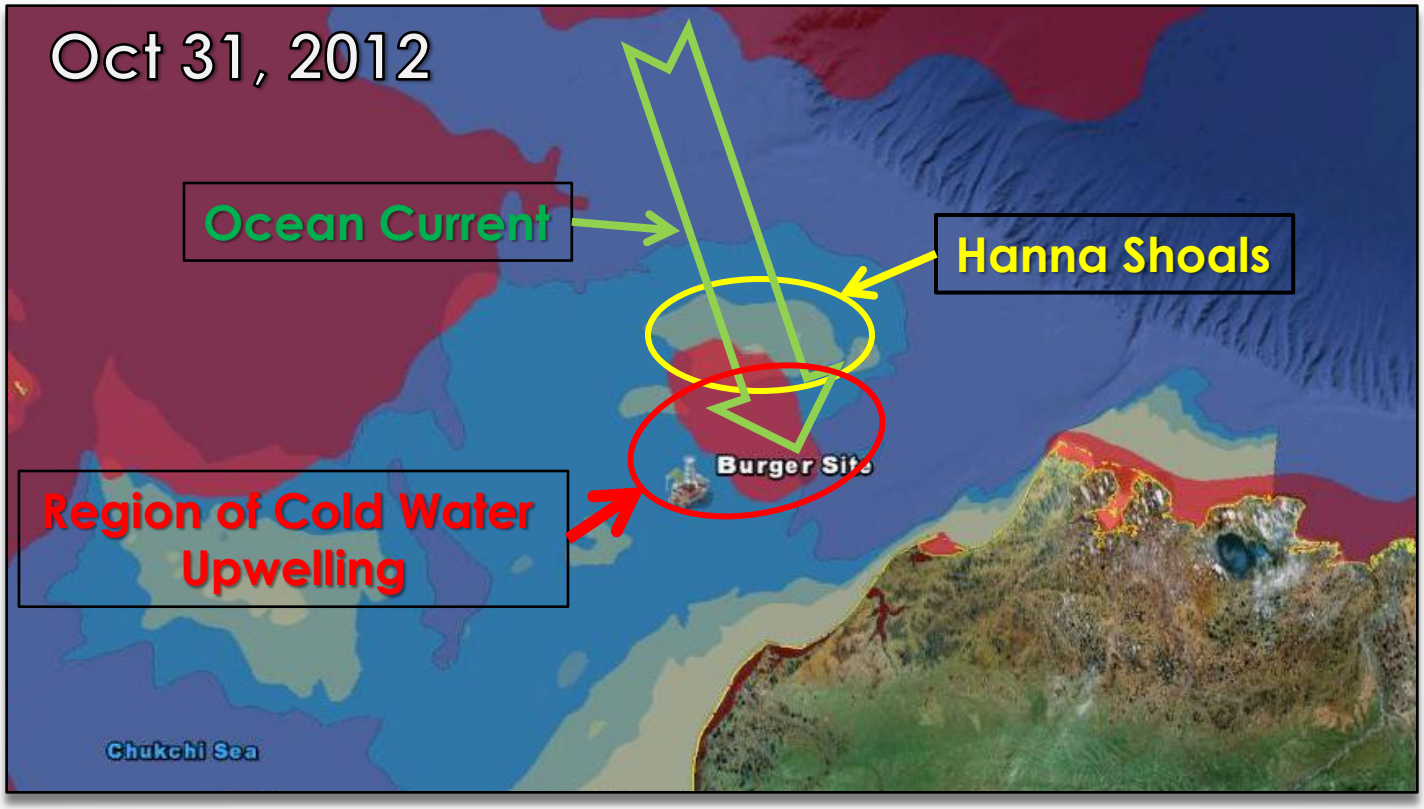
Freeze-up at Burger Site

RADARSAT-2 (R-2) Synthetic Aperture Radar (SAR) Surface Winds Products



Courtesy of the NIC

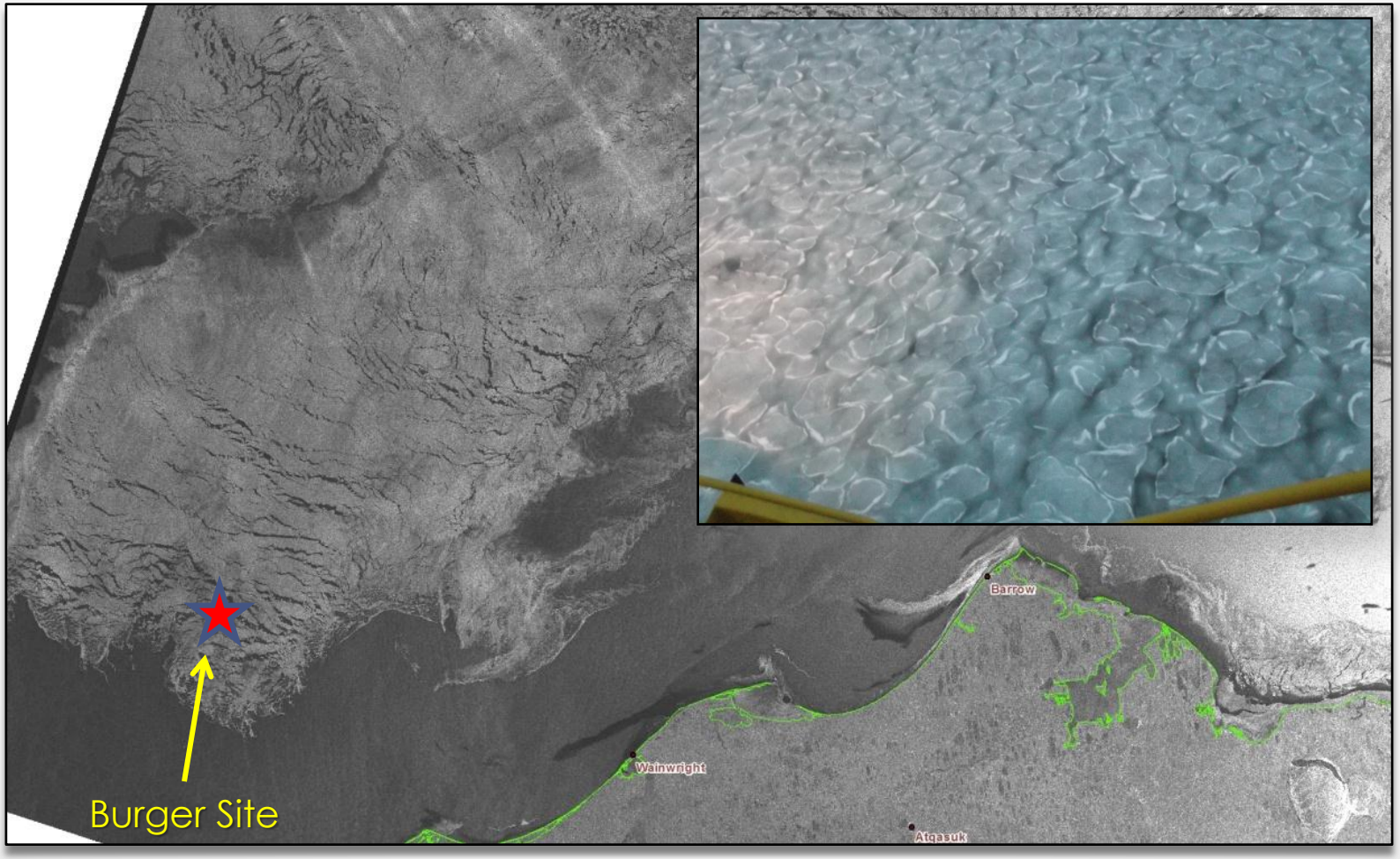
Why Ice Formed First Near Burger Site



Red Shading = Sea Ice Coverage

Blue to Greenish Gray Shading = Sea Floor Depth

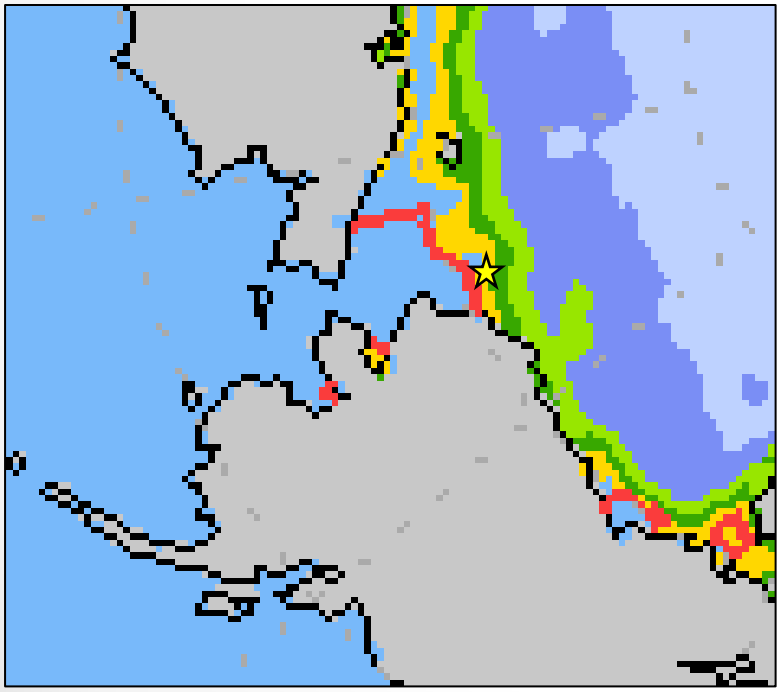
Early November at Burger



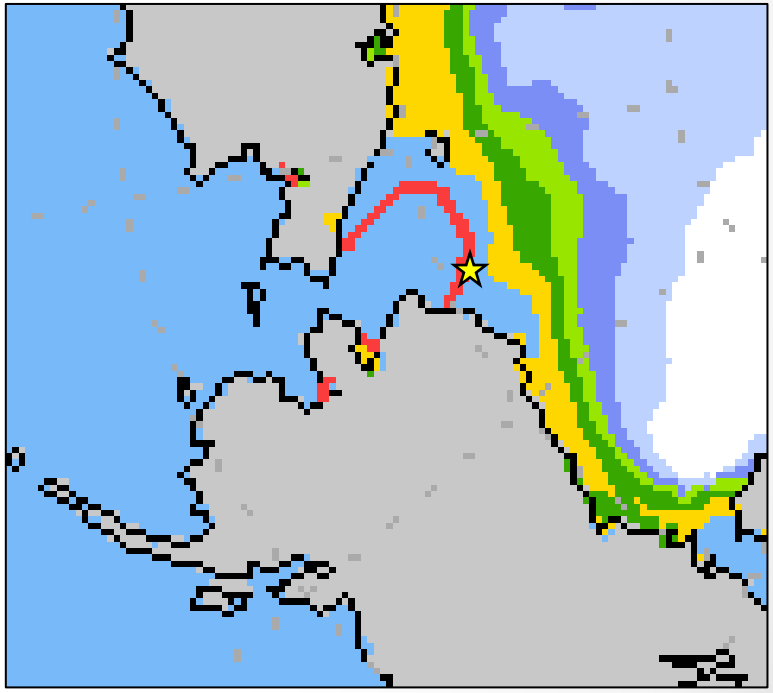
Radar Sat Image and photograph (courtesy of Shell)

Future BOEM Support: The Length of the open water Season

- BOEM Recognized that the most critical information for operations planning in the Arctic is the length of the open water season
- Some years may have too short of an open water season to expend resources, others may have long open water season to maximize resources spent



July 2013



October 2013

Mean Monthly Sea Ice Concentration
(NCEP Climate Prediction Center's CFS Model)

Lessons Learned and Challenges

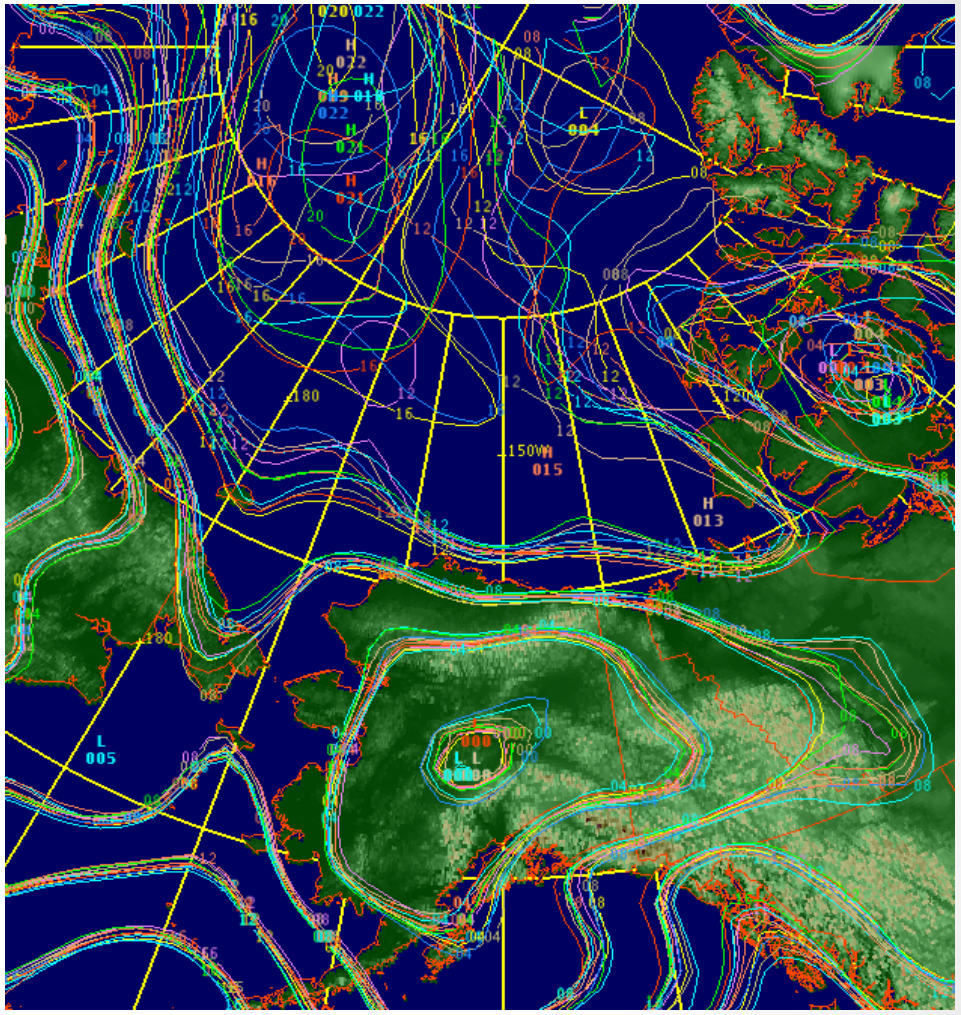
- Weekly discussions with BOEM and Shell Ice Forecasters proved invaluable in understanding capabilities, needs, decision points, etc., to establish a future CONOP

- Short term weather / Sub-surface temperature, salinity, and ocean observations are crucial for understanding and anticipating ice melt out / freeze up.
  - *A single event can accelerate or delay freeze-up by several days.*
  - *Current forecast skill is lower in the Arctic then at lower latitudes*
  - *At these shorter time scales, scientific understanding and models need to be adequate to capture the fine detail interactions between the ice, ocean, and atmosphere.*

- Seasonal Weather / Climate / Sea Ice Forecasts – Much work required for improvement to support the Increasing Arctic
  - *Increased observational datasets can help improve understanding of antecedent conditions, which "Sets the Stage" for ice melt out and freeze up.*
  - *Mutli-Billion Dollar Decisions are being made 6-8 months before activity begins*
  - *Week 2 – Week 6 forecasts are critical to determine feasibility of maintaining operations or the ability to respond to an event due to lack of infrastructure nearby*
  - *Having an understanding of "What is Possible" works well with the Risk Management style of regulators, planners, developers in the Arctic. Probalisitic Forecasts*

Why do we need more observations in the Arctic?

- Large Model Differences in Initial Conditions are very common over the Arctic
- Often leads to poor and inconsistent model performance with significant Arctic Weather features.
- Weather is the short term driver of local Sea Ice Changes



Comparison of Multiple Weather Model Sea Level Pressure Initializations over the Arctic

Sea Ice Can Be Good?

- Sea Ice Helps Dampen Sea State
- In the past 10-15' foot seas were the normal maximum in ice free conditions
- In an ice free arctic 25'+ seas could be the new normal mariners and coastal communities may have to design and plan for

Questions?

Thank you